



# Hangman's fracture presenting to chiropractic clinic as benign neck pain: a case report

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## Abstract

**Objective:** The purpose of this study is to report a patient who presented to a chiropractic clinic with benign neck and upper back pain; however, the patient also had a recent hangman's fracture due to a drunken fall.

**Clinical features:** A 40-year-old established patient with neck and upper back pain presented to a chiropractic clinic for care. When questioned about the character and etiology of his pain, he reported that it was no different compared to past presentations, saying "it's the same as always." The patient was not questioned about recent trauma and did not report his fall while intoxicated several days prior. After history and examination, the working diagnosis was a low-grade cervical sprain strain with imaging considerations if improvement did not occur quickly as was observed with similar previous presentations. Treatment included chiropractic mobilization of the cervical spine. The following day, the patient reported no improvement. Upon additional questioning, a history of trauma was revealed; and plain radiographic imaging showed a C2 vertebral body fracture.

**Intervention and outcome:** Immediate referral and evaluation at a local emergency center revealed not only an unstable C2 fracture but a coronal fracture of the left frontal bone extending into the left temporal bone with an associated right subdural hemorrhage along the right hemisphere and tentorium. The patient was placed in a sterno-occipital-mandibular immobilizer brace and discharged 2 days later.

**Conclusion:** Historical experience with similar clinical presentations in established patients can influence health care providers to assume a benign causation of symptoms. Conscious effort must be exerted to treat established patients with typical presentations with the same diligence as those of new patients to a chiropractic clinic. This case illustrates that an unstable fracture and hematoma can present to a chiropractic clinic as a seemingly benign problem.

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## Introduction

A hangman's fracture is a bilateral pedicle fracture of the axis (C2) with anterior displacement of C2 upon C3.<sup>1</sup> The injury is often caused by falling down or being involved in a vehicular accident producing cervical hyperextension. Although this fracture is unstable, survival is relatively common. The fracture tends to expand the spinal canal at the C2 level. It is not unusual for patients to walk in for treatment lacking neurological findings and have this fracture discovered upon imaging. Only if the force of the injury is severe enough that the vertebral body of C2 is severely subluxed from C3 does the spinal cord become crushed, usually between the vertebral body of C3 and the posterior elements of C1 and C2.<sup>2</sup>

The hangman's fracture was described by Schneider et al.<sup>3</sup> The predominant cause of hangman's fracture is motor vehicle trauma; however, falls and diving accidents are also noted.<sup>4-12</sup> As patients who experience these injuries also seek out chiropractic care for relief of neck and back pain, it is likely that patients with previously undetected fractures may present to these offices. The purpose of this study is to report a patient who presented to a chiropractic clinic with apparently benign neck and upper back pain; however, he had a recent hangman's fracture due to a drunken fall.

## Case report

A 40-year-old male patient with a 10-year history of intermittent neck pain and acute torticollis presented to the treating chiropractor's clinic with neck and upper back pain. The patient was an established patient. In the previous 10 years, he had been managed successfully 6 times by the treating doctor of chiropractic for the recurring chief concern. Each episode responded immediately to chiropractic management with minimal intervention. Historically, this patient's neck and upper back pain was associated with his occupation as a machinist that included overhead work. He had minimal education and worked as a "blue collar" worker.

On the day of his seventh episode, he assured the treating chiropractor that the character and etiology of his pain were no different compared to past presentations by saying, "it's the same as always."

He reported a minimal headache at the base of the skull and neck pain, both of which had been occurring over the past 3 days prior to his presentation. He denied any numbness, tingling, or pain into his extremities. He

was casually attired and presented after a day's work. He drove himself to the office and was in no overt signs of distress.

Static palpation showed muscle splinting of the right posterior muscles and tenderness of the suboccipital musculature—left greater than right. Active cervical spine ranges of motion were reduced in right rotation (20° of 80°) and left rotation (30° of 80°). All other cervical ranges of motion were observed to be normal. Passive ranges of motion were somewhat resisted in left and right lateral flexion with relatively free intersegmental motion in the posterior and anterior direction. Maximum cervical compression tests caused some increase in the posterior joint tenderness without radiation into the extremities.

The working diagnosis was a low-grade cervical sprain strain with imaging considerations if improvement did not occur quickly as was observed with similar previous presentations. Treatment on this day included mobilization of the cervical spine with manipulation of the thoracic spine. Self postisometric relaxation exercises were also prescribed, although poorly reproduced by the patient upon instruction.

The patient returned the next day and was upset that he did not experience relief for his neck pain and discomfort. Upon additional questioning by the chiropractor, the patient reported that, 4 days earlier, he "stumbled down some stairs, but did not fall down," although he did "fall against the side of the wall." He had a small abrasion about the size of a quarter on his left cheekbone. This was not questioned on the previous visit. He had a history of heavy alcohol consumption and had in the past presented for treatment with the smell of alcohol on his breath. He did not appear to be impaired by anything but his neck pain in the last 2 presentations. He also admitted that he was drinking at the time of the fall but denied alcohol intoxication.

New historical data (intoxicated fall and facial abrasion) coupled with a lack of symptomatic improvement consistent with past treatment plans prompted the doctor of chiropractic to refer the patient to a local medical clinic for cervical radiographs. Within 30 minutes, the patient returned with his radiographs that revealed a C2 vertebral body fracture through the lamina with a fragment of bone displaced from the posterior vertebral body. There was a 2- to 3-mm anterolisthesis of C2 on C3 and the appearance of a facet dislocation (Fig 1).

An immediate referral was made for his transport to the nearest emergency department (ED) via ambulance. He initially refused, not understanding the severity of his presentation. He believed this to be an overreaction



**Fig 1.** Lateral plain radiograph of the cervical spine.

because he had been “just fine” for the last 4 days. The patient’s low educational attainment complicated his ability to understand the gravity of the situation. He suggested that he could drive himself to the ED, as he was more concerned about the welfare of his “classic car” in the clinic parking lot than he was about his neck. As the treating chiropractor would not allow the patient to drive himself, the compromise agreeable to the patient was to call a friend to transport him to the nearest ED. The ED was called and made aware of this situation and his impending presentation.

Upon arrival to the ED, he was more forthcoming regarding his history and mechanism of injury. His story changed, and he reported that he fell down 13 stairs 4 days prior. He stated he tripped over his dog and admitted freely to having been drinking. Physical examination in the ED revealed dried blood in the left external auditory canal as well as a left cheek abrasion. He underwent computed tomography (CT) of his head cervical spine (Fig 2). The head CT demonstrated a right-sided subdural hematoma and a coronal fracture of the left frontal bone extending into the left temporal bone. The CT of the spine demonstrated a hangman’s fracture of approximately 2 to 3 mm of C2 on C3 subluxation. He was admitted to the trauma center.

## Intervention and outcome

The patient was immobilized in a neck brace (sternal occipital mandibular immobilizer) and discharged to home 2 days after his presentation to the ED (Fig 3). The brace was to be worn for 12 weeks. One-month



**Fig 2.** Computed tomography of the cervical spine, coronal view, demonstrating fracture of C2.



**Fig 3.** Lateral plain radiograph of the cervical spine with halo brace in place.



**Fig 4.** Lateral plain radiograph of the cervical spine after treatment.

follow-up imaging of the cervical spine demonstrated the C2 fracture with 4-mm anterior subluxation of C2 on C3 considered stable with no new abnormalities. At the 2-month follow-up, flexion and extension views as well as cervical anteroposterior and lateral radiography were performed. The radiographs demonstrated a stable posttraumatic cervical spine with no change in amount of subluxation of C2 on C3 with flexion and extension (Fig 4).

The patient presented to primary care for new pain and numbness in the right hand 21 months after his drunken fall. Imaging of the cervical spine, including an oblique view, was ordered. The radiographs demonstrated a C2 pedicle fracture not clearly seen. Slight narrowing of the C2-3 disk space with mild spurring of the vertebral endplate was noted. There was slight retrolisthesis of C3 in relation to C2 and C4. It was noted that the retrolisthesis in relation to C2 appears to have improved from the prior study.

## Discussion

In this case, a hangman's fracture resulted from a drunken fall down several stairs. The established patient presented with benign symptoms similar to his past presentations and was observed to be without neurological deficits. Lack of immediate response to care similar to this patient's previous episodes of neck pain led to further questioning and imaging of the cervical spine revealing the fracture.

Despite the fact that the patient was ambulatory and presented without neurological deficits similar to his past presentations to the same chiropractic clinic, the clinician in this case should have exercised more caution during the first patient encounter. The error in clinical decision making was preceded by an incomplete patient history as well as an incomplete physical examination, as the observation of a facial abrasion was not questioned during the initial visit. It is not clear why the patient chose not to reveal that he experienced a fall days prior to the visit to his chiropractor. He may have consciously decided not to mention the fall because it was not affecting his function, the pain was not severe, or he may have felt embarrassed to report about the event.

Retrospectively, one could speculate that if the clinician had observed the facial abrasion and followed up with a line of questioning pertaining to this observation, the patient may have been more forthcoming regarding the full history of mechanism of injury—an intoxicated fall down 13 stairs. This mechanism alone would have prompted an alert clinician to order cervical radiographs in accord with the Canadian C-Spine Rule.<sup>13</sup> There is little room for doubt that the judgment of the clinician in this case was clouded by past presentations of similar seemingly benign episodes of neck pain.

The term *hangman's fracture* was first coined by Schneider et al<sup>3</sup> in 1965 in a case series presentation of 8 surviving patients injured in motor vehicle collisions, each presenting with an avulsion fracture of the neural arch of C2 (6 of 8 specifically noted to be bilateral). The pattern of axis fracture via motor vehicle collisions was correlated with the mechanism and pattern of injury observed in victims of modern judicial long-drop hanging first described by Haughton in 1866 and the use of a submental knot to produce an axis fracture recommended by Wood-Jones.<sup>4-6,14,15</sup> Several subsequent authors point out that it is actually the hangee sustaining the aforementioned injury and not the hangman acting as the executioner.<sup>5,7,16</sup> James and Nasmyth-Jones<sup>17</sup> question the predominance of axis fractures produced by judicial hanging all together after examining 34 victims and finding only 6 cases of axis fracture.

Bilateral fracture of the neural arch of C2 without disruption of the odontoid process is an essential element of the hangman's fracture.<sup>3,6,7</sup> Accompanying bony injuries may include fracture-dislocation of the body of C2 on C3, vertebral body fracture of C3, spinous process fractures of the cervical spine, and fracture of the posterior arch of the atlas.<sup>6-10</sup>

The predominant modern causation of the hangman's fracture is motor vehicle trauma. Falls and diving



accidents are also noted but with less frequency.<sup>4-12</sup> Similar to judicial long-drop hanging, forced hyperextension of the upper cervical spine is largely implicated in causing the neural arch fracture of C2.<sup>3,6,16</sup> This force is imparted when an occupant's facial and/or frontal region impacts a slanted windshield during frontal and roll over collisions. Falls and diving accidents may also result in hyperextension and compressive loads.<sup>9</sup> Unlike the mechanism of judicial hanging, which includes traction to the entire motion unit, occupant/windshield impact may include compression to at least some elements of the motion unit during some part of the impact.<sup>4,6,10</sup> The morphology of the axis as a transitional vertebra undoubtedly plays a role in the hyperextension mechanism, whereas the odontoid process acts as a lever arm inducing force onto the neural arch.<sup>4,5,16</sup> Additionally, some hangman's fractures are produced with cervical flexion.<sup>9,10</sup>

Cervical rigidity secondary to muscle spasm and cervical pain is commonly noted in patient presentation.<sup>4,6,9,18</sup> Consistent with the presentation of the patient in this case study, facial abrasions and scalp abrasions were also common among cases presented—especially those resulting from falls.<sup>7,9,10</sup> As most modern cases result from motor vehicle trauma, other bodily injuries including skull fractures may be present accompanying hangman's fracture.<sup>9</sup>

Although neurological deficit is present in some cases, most authors note a surprising lack in the prevalence of neurological deficits or findings resulting from hangman's fracture.<sup>3,6-10,12</sup> This is thought to occur because of the widening of the spinal canal as the neural arch is avulsed from the anterior elements of C2.<sup>7,9</sup> Fatalities resulting from judicial hanging are thought to occur because of axial traction of the unprotected spinal cord after fracture. Interestingly, Houghton<sup>14</sup> in 1866 wrote that a “shock” to the medulla oblongata was requisite to produce a quick and humane death without evidence of struggle or asphyxia.

Diagnosis may be made initially using lateral cervical radiographs and is often accompanied by CT.<sup>9,12,19</sup> Francis et al<sup>9</sup> discontinued use of CT early in one study after determining that lateral radiographs were sufficiently reliable. Hangman's fractures were initially categorized by Effendi et al<sup>5</sup> as being type I (isolated hairline fractures with minimal displacement), type II (anterior displacement of the vertebral body with or without angulation), or type III (anterior displacement of the vertebral body with severe flexed angulation and dislocation of the C2-3 facet joints). Levine and Edwards expounded on the Effendi et al classification by adding type IIa (secondary to cervical

flexion and distraction).<sup>20,21</sup> The categories are defined by translation and angulation of the vertebral body of C2 in relationship to the previously attached neural arch and the body of C3.<sup>9</sup> Type III classifications are observed to be the most translated and severely angulated. This classification is associated with instability.<sup>5,10</sup> Francis has also proposed a classification system although it is not widely referenced.<sup>20</sup>

Most authors suggest that nonsurgical management is appropriate if neurological deficit and potential for long-term instability are absent.<sup>6,16,20,21</sup> This conservative treatment includes traction and external soft or usually external ridged bracing as in the halo apparatus.<sup>5,8-10,22</sup> Li et al suggested soft bracing only in some stable Effendi type I and Levine Edwards type II fractures, while suggesting that the majority of cases should be managed with traction and ridged external immobilization. Surgical stabilization is recommended by Li et al<sup>20</sup> in cases of later possible instability.<sup>21</sup>

## Conclusion

Historical experience with similar clinical presentations in established patients can influence health care providers to assume a benign causation of symptoms. Conscious effort must be exerted to treat established patients with typical presentations with the same diligence as those of new patients to a chiropractic clinic. This case illustrates that an unstable fracture and hematoma can present to a chiropractic clinic as a seemingly benign problem.

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